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(54) VACUUM SANDER

(71) I, MIKSA MARTON of R.R.# 1, Old Castle, Windsor, Ontario, Canada, a citizen of Canada, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is directed to a vacuum sanding device. More particularly, the invention is directed to a vacuum sanding device that has one or more vacuum openings in the central area of the sanding disc, or, one or more vacuum openings located around the periphery of the sanding disc, or a combination of one or more openings in the central area of the sanding disc and one or more openings located around the periphery of the sanding disc.

Sanding devices are widely used in a wide variety of manufacturing operations. For example, in the automobile manufacturing industry, sanding systems are used to prepare the metal surface of the car body for receiving one or more coats of paint primer, and one or more finishing coats of paint. Frequently, one or more of the intermediate layers of paint must be sanded or touched up by sanding in order to smoooth rough edges and other imperfections in the finish before the final coat of paint is applied.

Sanding is a necessary procedure in providing a smooth surface to the finished article and is therefore virtually indispensable. However, there has been a perennial problem associated with any sanding operation, and even more so with sanding operations that are conducted using high speed mechanical equipment. The material that is sanded away from the surface being prepared is given off in the form of a fine dust. Frequently, this dust is so light that it hangs in the air for a period of time before settling.

In large scale sanding operations, using high speed mechanical equipment, a large quantity of fine dust is generated which creates very uncomfortable working conditions for the workmen. The fine dust floats in the air for a considerable amount of time and is breathed in by the workmen, settles on their clothing, and all exposed surfaces surrounding the sanding operation. The dust is therefore an acute nuisance.

Many attempts in the past have been made to reduce the dusting problem associated with high speed, large scale sanding operations. One method of reducing the dusting problem, particularly in automobile manufacturing plants, is to continuously bathe the working surface with a moving film of water that carries away the fine material that has been abraded away by the sanding machine. This is known as "wet sanding". However, this system, while it keeps dusting to a minimum, uses considerable quantities of water, and makes working conditions uncomfortable for the workmen. The workmen must wear waterproof clothing, and the generally wet conditions throughout the sanding plant create a cold and uncomfortable environment.

It would be preferable if a "dry sanding" system, which did not have a dusting problem, could be devised. Efforts in this direction have been made by attempting to suck the dust out of the air by means of a vacuum system. However, these efforts to date have been only marginally successful. It has been possible to draw away only a small proportion of the dust by using the systems designed to date. Considerable dust remains in the air and is inhaled by the workmen and settles on the workpiece as well as surrounding objects.

A further problem associated with "dry sanding" metal and plastic objects is that the abraded material develops an electrostatic charge which causes the dust to adhere to the surface of the workpiece being sanded. Vacuum systems designed to date have been unsuccessful in removing the dust that clings electrostatically to the surface of the workpiece.

To alleviate the foregoing problems associated with "dry sanding", I have previously developed a vacuum sanding system that is very effective in drawing away the dust developed by the sanding machine, using a vacuum chamber that encloses the sanding pad and sanding disc. The chamber has a plurality of openings that are distributed about the periphery of the circular sanding disc of the sanding device. This system has the advantage of placing the vacuum openings very close to the area of the workpiece where the material is being abraded free of the workpiece, and, as a consequence, almost no dust escapes being drawn away by one of the vacuum openings.

However, while very efficient, this vacuum system has two disadvantages. The vacuum housing obscures the sanding disc and backup pad from view by the workman. As a result, the workman doing the sanding is not able to see the edge of the sanding disc as it sands away the material from the workpiece. A considerable amount of sanding is done on special areas, using only one side of the sanding disc, and in order to sand these areas smoothly, the workman prefers to be able to see the surface as it is being sanded. This is not possible with the vacuum chamber system since it encloses and hides the sanding disc.

The second disadvantage is that the vacuum chamber surrounding the sanding disc acts as a bumper of sorts and prevents the sanding disc from running up to the extreme edge of any workpiece that has an upraised border or obstruction on it. In such situations, it is necessary to sand the unsanded border areas using a sanding device that does not have a vacuum chamber surrounding the sanding disc. This is a nuisance, is time consuming and generates a certain amount of dust that coats the other areas of the workpiece.

According to the invention there is provided a vacuum sanding apparatus comprising in combination, a disc shaped backup pad for connection to driving means and having detachably secured thereto on one surface a sanding disc having an abrasive surface, a vacuum housing mounted adjacent the opposite surface of the backup pad; at least one aperture in the abrasive surface of the sanding disc and being in registry with apertures in said one surface of the backup pad, all said apertures being in communication with the interior of said vacuum housing; means on the housing for adjusting the amount of vacuum created therein; said housing being connectable to the driving means and being adapted to receive the same centrally in the housing; and a resilient collar intermediate the peripheral edge of the housing facing the backup pad and said opposite surface of the backup pad whereby the housing may flex relative to the plane of the backup pad.

Co-pending applications 12489/78, 12490/78, 12491/78 and 12488/78 (Serial Nos. 1 532 774, 1 532 775, 1 532 776 and 1 532 773) divided from this application relate to similar subject matter.

Examples of the invention will now be described with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of a pneumatic sander with a backup pad and vacuum housing attachment;

FIGURE 2 is a top view of a backup pad cover;

FIGURE 3 is a top view of the backup pad shown in FIGURE 1;

FIGURE 4 is a cut-away side view of the backup pad shown in FIGURE 3;

FIGURE 5 is a cut-away view of the backup pad shown in FIGURE 4, with the backup pad cover shown in FIGURE 2;

FIGURE 6 is a top view of a sanding disc with peripheral flexible skirt;

FIGURE 7 is a perspective view of a sander, vacuum housing, and a back-up pad with the sanding disc shown in FIGURE 6 mounted on the backup pad;

FIGURE 8 is a partially cut-away view of the sander, vacuum housing, and backup pad;

FIGURE 9 is a perspective view of a sander, vacuum housing, backup pad, and a single central suction opening sanding disc mounted on the backup pad;

FIGURE 10 is a side view of an 8 inch back-up pad with reinforcing disc;

FIGURE 11 is a perspective view of an 8 inch pneumatic sander, suction housing, 8 inch backup pad, and an 8 inch sanding disc mounted on the backup pad;

FIGURE 12 is a raised dimensional view of the suction housing shown in FIGURE 11;

FIGURE 13 is an underside perspective view of the vacuum housing shown in FIGURES 12 and 13;

FIGURE 14 is a three dimensional view of an 8 inch backup pad and reinforcing disc as shown in FIGURE 10.

FIGURE 15 is a top view of a sanding disc with a single central suction opening, and closed peripheral suction openings;

FIGURE 16 is a partially cut-away side view of a backup pad with a doughnut softening pad mounted thereunder, and a sanding disc mounted on the backup pad;

FIGURE 17 is a partial section view of a sanding disc loading device;

FIGURE 18 is a cut-away view of a backup pad similar to FIGURE 5 except only centre suction openings are shown; and

FIGURE 19 is a top view of a sanding disc with a single central suction opening, and closed peripheral suction openings located in the periphery of the sanding surface.

Referring to Figure 1, a pneumatic sander 1 driven by compressed air received through compressed air line 1a, drives a backup pad 2, which has mounted above it a suction housing 10 with suction outlet 13. Figure 1 shows peripheral suction openings in the backup pad 2. Central suction openings in the backup pad are also present.

The backup pad 2, is constructed of a backup pad cover 4 together with a ribbed reinforcing disc 8, which is affixed to and overlies a backup resilient pad 9. (See Figure 3 for more details.) The resilient pad 9 can be of various degrees of softness to suit the type of sanding job that is desired. The backup pad 2 has located around its periphery one or more peripheral suction holes 7. In practice, the suction outlet 13 is connected to a vacuum source which draws a vacuum on the suction housing 10, and the overall backup pad system.

The backup pad cover 4, and the ribbed reinforcing disc 8, are normally constructed of semi-rigid slightly flexible materials, which, when flexed, tend to create an opening between the backup pad cover 4, and the bottom of the suction housing 10. To provide a suction seal, a suction sealing ring 3 is mounted around the periphery of the suction housing 10, immediately above the backup pad cover 4. The suction sealing ring 3 is usually constructed of rubber, or similar elastic material, and is cut to oversized dimensions so that there is a certain amount of slack 3a in the middle of the sealing ring 3. Since the sealing ring is constructed of elastic material, the slack maintains a constant downward pressure on the backup pad cover 4. To prevent the suction sealing ring 3 from riding up on the suction housing 10, a suction housing sealing ring seat 14 is located around the periphery of the suction housing 10, below the suction outlet 13. This sealing ring seat 14 can be formed in the suction housing 10, or can merely be a metal ring, or the like, fastened to the circumference of the suction housing 10. The ribbed reinforcing disc 8 has located around its circumference a peripheral groove 23, which is used for mounting a sanding disc on the backup pad by means of an O-ring as will be explained in detail later in this specification.

A suction shut off device is located on the housing 10. The device consists of a horizontal slot 76 with a suction shut off plate 77 mounted behind the plate. A knob 78 is attached to the plate 77. The plate 77 slides horizontally behind the slot 76. When the knob 78 is pulled fully forward as shown in Figure 1, the suction housing 10 is completely closed and any vacuum drawn on the housing 10 through suction outlet 13 is transmitted to the suction holes 7. When the knob 78 is pulled back to the right hand end of the slot 76 as seen in Figure 1, the plate 77 slides inside housing 10 and closes off suction outlet 13. It is advantageous to be able to shut off the suction when sandpaper is being changed on the backup pad 2. Otherwise, the sandpaper tends to get sucked into the suction holes 7, and can become torn or badly bent. Locating the knob 78 and plate 77 at intermediate positions along the slot 76 permits the degree of suction drawn on the suction housing 10 to be adjusted.

Referring to Figure 2, it will be seen that backup pad cover 4 has located therein one or more backup pad cover suction openings 5, and in the centre thereof a receiving hole 18.

Figure 3 shows a top view of ribbed reinforcing disc 8 and backup pad resilient pad 9, with one or more centre suction holes 6 located in the central area thereof and one or more peripheral suction holes 7 around the periphery of the backup pad. A bolt 17 is located in the centre of the ribbed reinforcing disc 8. The backup pad with both centre and peripheral suction openings provides the most efficient dust removal action. An arrangement of eight centre and eight peripheral suction openings provides good dust removal action.

Figure 4 shows a section view of Figure 3, taken along section lines A-A. It can be seen that the central suction holes 6 penetrate completely through the disc 8 and pad 9 of the backup pad 2. The peripheral suction holes 7 connect the top interior region of the backup pad ribbed reinforcing disc 8 with the exterior of the peripheral area of the backup pad resilient pad 9.

Figure 5 shows a section view of the backup pad, with a backup pad cover 4 mounted above the ribbed reinforcing disc 8. The backup pad cover has suction openings 5 located therein, and the suction openings 5 communicate with both the centre suction holes 6 and the peripheral suction holes 7 of the backup pad. The backup pad with these suction openings located therein becomes in effect a rotating vacuum chamber under operating conditions.

Figure 6 illustrates a sanding disc 15 that is used in association with a backup pad system which has both central and peripheral suction openings such as that disclosed in Figures 1 to 5 inclusive. The central area of the sanding disc consists of a circular disc 15, with a peripheral flexible skirt 16 attached thereto. The central disc 15 has a plurality of suction openings 20 located in the central area. The flexible skirt 16 has a number of radially extending suction openings 21 spaced more or less equally around the circumference of the flexible skirt 16. The sanding disc 15 has abrasive grit 22 affixed to the surface of the sanding disc 15. This area is used for the actual sanding operation. No grit 22 is affixed to the flexible peripheral skirt 16. The sanding disc 15 has a centering hole 19 located in the centre thereof. This centering hole 19 is of assistance in lining up and attaching the sanding disc 15 and the flexible skirt 16, to the backup pad 2, as will be explained later in this specification.

Figure 7 shows a side view of a sander 1, vacuum housing 10, and backup pad arrangement, with a sanding disc as shown in Figure 6 fastened to the bottom and side surfaces of the backup pad. The flexible skirt 16 is folded upwardly around the sides of the backup pad so that the flexible skirt suction openings 21 coincide with the peripheral suction openings 7 of the backup pad. Thus the flexible skirt 16 does not interfere with the passage of air through the peripheral suction openings 7. The flexible skirt 16 is held against the sides of the backup pad by means of an elastic O-ring 24 which rests in the peripheral groove 23 of the reinforcing disc 8 (See Figure 1). The sanding disc 15 is attached to the backup pad so that the grit side of the sanding disc 15 faces away from the backup pad and toward the surface of any workpiece surface that requires sanding.

Figure 8 shows a partially cut-away view of the backup pad and suction housing combination and the air flow pattern that is created when a vacuum is applied to suction outlet 13. A vacuum at suction outlet 13 can be applied by using a two horse power industrial type vacuum cleaner, such as the portable industrial type vacuum cleaner that is manufactured under the trade mark EUREKA. This vacuum cleaner has a 1¼ inch suction hose, which is ideal for attaching to the suction outlet 13. In Figure 8, it can be seen that air is drawn in through the centre suction holes 6, as well as the peripheral suction holes 7. The air from these two sources is then drawn through the suction holes 5 in the backup pad cover 4. The air is then collected in suction housing 10 and is exhausted through suction outlet 13. With this system of connecting the suction openings, it is possible to draw air through openings 6 and openings 7 even when the backup pad 2 is being rapidly rotated by the sander motor 1 and housing 10 remains stationary. Figure 8 also demonstrates the manner in which the backup pad 2 is connected to the drive shaft 25 of the sander 1. The drive shaft 25 of the sander 1 has a chuck 26 at the lower end thereof. A tightening nut hole 27 is located in the chuck 26. The bolt 17 of the backup pad 2 (See Figure 4) is screwed into chuck 26, and is then secured in place by means of tightening nut hole 27.

Figure 9 shows an upwardly tilted perspective view of the sander 1, suction housing 10, and backup pad combination with the underside of the backup pad and the sanding disc 15 visible. Eight centre suction holes 6 are distributed evenly around the central area of the backup pad 9. These radially correspond in position with the peripheral suction holes 7. It has been found convenient to radially co-ordinate the positioning of the centre suction holes 6 and the peripheral suction holes 7 for purposes of both manufacturing and sanding disc mounting.

The sanding disc 15 as shown in Figure 9, has only one centre suction hole 28. It differs in this respect from the sanding disc shown in Figure 6. The sanding disc 15 shown in Figure 6 can also be used, with the eight suction openings 20 aligned in position with the eight suction openings 6 in the backup pad. The flexible skirt 16 of the sanding disc 15 is secured to the backup pad by rubber O-ring 24.

Figure 10 shows a larger sized backup pad 29 which is known in the trade as an 8 inch backup pad. The 8 inch backup pad is constructed of a circular semi-flexible sponge-like material 29 which has mounted on the top thereof a reinforcing disc 30. The reinforcing disc 30 is manufactured of a semi-rigid material having only limited flexibility. A plurality of centre suction holes 31 extend vertically through the reinforcing disc 30, and the backup pad 29. A series of peripheral suction holes 32 can be arranged around the periphery of the backup pad 29. These peripheral suction holes 32, when present, can be joined with the centre suction holes 31 as shown by the dotted lines in Figure 10. Thus, when peripheral openings 32 are present, a vacuum applied to the top of holes 31 will draw air in through both peripheral openings 32 and the bottom of centre openings 31. A peripheral groove 42 is built into the backup pad 29. A suction housing is shown in dotted lines in Figure 10 overlying the reinforcing disc 30 and backup pad 29 combination.

Figure 11 shows an 8 inch backup pad in combination with the 8 inch suction housing 34, and an 8 inch pneumatic motor 33. The pneumatic motor is air driven by means of an air turbine which is rated at 1¼ horse power. A suitable air turbine motor can be purchased under the trade mark DOTCO and rotates the sanding disc 32 at about 1500 rpm.

The suction housing 34 consists of a suction outlet 35, and a sealing ring 36. The sealing ring is constructed of rubber, or some other suitable elastic material, and can be stiffened to withstand vacuum pull by adding a reinforcing layer of canvas, or some other suitable material. The sealing ring is held in place by a rubber band 37. The suction housing 34 and sealing ring 36 overly the reinforcing disc 30. The suction housing 34 is secured to the pneumatically driven motor 33 by means of an adjustable clamp 43.

An 8 inch sanding disc 39 is held in place on the 8 inch backup pad by means of an 8 inch flexible skirt 40, and an 8 inch O-ring 41. The openings in the flexible skirt 40 coincide with the peripheral suction holes 32 of the 8 inch backup pad, when peripheral openings 32 are present.

It has been found that in operation, when a backup pad having only central suction openings is used, and when a vacuum is applied to the suction opening 35, the 8 inch backup pad and sanding disc 39 combination is held against the workpiece with such force that it is difficult for the workman to move the 8 inch sander about the surface of the workpiece. Accordingly, in order to permit the sander to move about the workpiece by manual manipulation, it is necessary to have an adjustable suction control valve 38 located in the suction housing 34. This permits the vacuum force in the housing 34 to be adjusted so that the sander is held against the surface of the workpiece with only moderate force. When peripheral suction openings are present, the holding force against the workpiece surface is negligible and a suction control valve 38 is not necessarily required.

Figure 12 shows a perspective view of the suction housing 34, with the sealing ring 36 and the rubber band 37 in place. The adjustable suction control valve 38 can be constructed by using a screw bolt 38a that fits through the interior of a vertical coil spring 44. A series of small control valve holes 45 are punched in the suction housing 34. The underside of the suction housing 34, as shown in Figure 13, shows the other components of the adjustable suction control valve 38. The screw bolt 38a fits into a control valve nut 47. The nut 47 holds a control valve disc 46 in place against the surface of the suction housing 34. In operation, when a vacuum is drawn on the interior of the suction housing 34 by means of suction outlet 35, the disc 46 is drawn inwardly against the force of the coil spring 44, thereby creating a slight opening between the disc 46 and the suction housing 34. Air is then drawn into the interior of the housing 34 through the control valve holes 45. The air drawn into the housing 34 relieves to a slight extent the suction drawn on the interior of the suction housing 34. The amount of relief can be adjusted to the preference of the workman handling the 8 inch sander by tightening or loosening the screw bolt 38a and the nut 47 combination which in turn adjusts the amount of tension on the coil spring 44. The degree of tension on the coil spring 44 regulates proportionally the degree of vacuum that can be drawn on the housing 34.

Figure 13 also shows a tightening slot 48 located in the side wall of the suction housing 34. This tightening slot 48 permits a suitable instrument to be inserted through the wall of the suction housing 34 in order to connect the backup pad 29 to the drive shaft of the motor 33.

Figure 14 shows a detail of the manner in which any peripheral suction holes 32 in the 8 inch backup pad are connected to the central suction holes 31. Because of the connection, the vacuum for both the peripheral suction holes 32 and the central suction holes 31 is drawn by means of the central holes 31. The peripheral suction holes 32 can be connected directly to the corresponding central suction hole 31 in a radial direction if this is desired. However, it has been found that as the backup pad 29 rotates at a speed of 1500 rpm., or thereabouts, better suction can be obtained through peripheral suction holes 32 by taking advantage of the rotational force of the backup pad 29. This is done by joining the peripheral suction holes 32 with the corresponding central suction holes 31 that immediately precede the suction holes 31 that are oriented radially with the peripheral suction holes 32. This system of connection gives a "pin-wheel" appearance to the orientation of the connecting channels 50 which are shown by means of dotted lines in the backup pad 29. Figure 14 also shows a bolt 49 which is used to connect the backup pad 29 with the motor 33 (See Figure 11).

An 8 inch sanding disc having central suction openings that correspond in position with the central suction holes 31 of the backup pad 29, and peripheral suction openings in the flexible skirt corresponding in position with the peripheral suction holes 32 of the backup pad 29, can be used for the 8 inch sander. Such a sanding disc may have much the same appearance as the disc shown in Figure 6. However, a modified version which has only a single central opening, can be used. The central opening in this version permits air to be drawn unhindered through the central suction openings 31 of the 8 inch backup pad. A further possible variation of sanding disc is shown in Figure 15. In that variation the sanding disc 51 has a single central opening 58. However, the flexible skirt 52, rather than having elongated openings that extend radially to the peripheral extremities of the flexible skirt, such as shown in Figure 6, has circular type openings 53. These openings 53 permit air to be drawn through the peripheral suction openings 32 of the 8 inch backup pad.

Other shapes and types of sanding disc can also be used in this invention. For example, the sanding disc can be simply a circular disc with or without a centre suction opening depending whether a similar suction opening is present in the backup pad. This shape of disc is glued directly to the bottom surface of the backup pad, in which case it is not necessary to have the flexible skirt 52. However, a disadvantage with glueing the sanding disc to the backup pad is that, with time, the glue tends to collect in and clog the central suction openings 31. Moreover, the old hardened glue tends to build up on the surface of the backup pad, creating mounds and valleys, which provide an uneven wearing surface to the sanding disc, thereby shortening the life of the sanding disc.

Sometimes, in specialized sanding operations, it is necessary to provide extra softness to the sanding pad. This is commonly done as shown in Figure 16 by using a "doughnut" softening pad 54. This pad 54 is constructed of a sponge-like material that has a softness suited for the application required. Such "doughnut" softening pads 54 can easily be incorporated in the sanding system as described above. In Figure 16, which shows a section view of the backup pad arrangement disclosed previously in Figure 5, the softening pad 54 is shown mounted under the resilient backup pad 9. The "doughnut" softening pad 54 has a central opening, and is held in place by a sanding disc 15, which also has a single central opening. The style of sanding disc shown in Figure 6 can also be used in this application so long as at least one suction opening is provided to enable the central suction openings of the backup pad to function properly. The sanding disc 15 is fastened to the backup pad by means of a flexible skirt 16, which is held in place by the rubber O-ring 24 as described previously.

A loader shown in Figure 17 is adapted to fasten a sanding disc and flexible skirt 52 together with a "doughnut" softening pad 54, to an 8 inch backup pad 29, reinforced by disc 30. However, minor modifications can be made to the basic loader, in order to adapt it for smaller sizes of backup pad, with or without doughnut softening pads. In the loader shown in Figure 17, loader housing 59, which has a generally hollowed out cylindrical shape, has positioned in the centre thereof a vertical centering pin 55. Around the centering pin 55 is located a sponge spring 56, which is constructed of a resilient spring-like material. Flexible polyurethane foam is suitable for spring 56, but a coil spring would work equally as well. Mounted on the sponge spring 56 is a centering plate 57. This centering plate 57 is shaped to accommodate a sanding disc and flexible skirt 52, having a single central opening 58, and a doughnut softening pad 54. An O-ring 41 is positioned around the circumference of the walls of the loader housing 59 as shown. The sanding disc 52, and the softening pad 54, are then placed one above the other on the centering plate 57 as shown. Then the 8 inch backup pad 29, and the reinforcing disc 30 are placed over the centering pin 55.

The flexible skirt 52 is fastened to the backup pad 29 by pushing down on the backup pad 29, softening pad 54, flexible skirt 52, and plate 57 combination, thereby depressing sponge spring 56, until the groove 42, in the circumference of the backup pad 29, is aligned with the upper edge of the loader housing 59. At this point, the rubber O-ring 41 is rolled upwardly off the loader housing 59, and snaps into place in the peripheral groove 42, thereby fastening flexible skirt 52 against the sides of the backup pad 29.

Figure 18 shows a cut-away view of a backup pad 60 which has only centre suction openings 61. A backup pad with only centre suction openings 61 has been found to be very effective in removing dust from the workpiece, notwithstanding that a backup pad with both central and peripheral suction openings has been found to be the most effective. Figure 18 shows the backup pad with a cover plate 62, although this can be eliminated by using a suction housing 10 (See Figure 8) that extends to the periphery of the backup pad reinforcing disc.

Figure 19 shows a sanding disc 66 with a single central suction hole 69, a flexible skirt 67, and a series of peripheral suction holes 68 located in the periphery of the sanding disc area 66, and not in the peripheral flexible skirt 67, as shown in Figure 6 or Figure 15. This type of sanding disc is intended for use with a backup pad that has peripheral suction openings located in the peripheral underside area of the backup pad rather than in the vertical sides of the backup pad as shown, for example, in Figures 1, 4, 5 and 7. One slight problem with having peripheral suction openings 68 located in the actual sanding area of the disc 66 is that sometimes the openings become caught in sharp projections on the workpiece and the disc becomes torn. However, sometimes it is advantageous to have the suction openings 68 on the underside periphery of the sanding disc 66 in order to obtain better suction action.

Example 1

A hood of a 1965 Ford automobile, painted with two coats of primer and four coats of green acrylic enamel was sanded using a five inch sanding pad and disc, 120 grit grade, driven by an Oribital air driven sanding motor, at a rotation of 8,000 rpm.

The Oribital sander was manufactured by Hutchins Manufacturing Company, Pasedena, California. The 120 grit grade sandpaper is commonly used in sanding operations in automobile assembly plants. The vacuum machine used to draw the suction action on the backup pad was a two horsepower portable industrial type vacuum cleaner sold under the trade mark EUREKA. The vacuum hose was approximately 1¼ inch in diameter.

The backup pad and sanding disc both had eight centre openings and eight peripheral suction openings located in the sides of the backup pad and the flexible skirt of the sanding disc. The central suction holes in the backup pad drew in loose material through the centre hole in the sponge ring, while the peripheral suction holes located about the periphery of the backup pad drew in any dust that escaped the edges of the rotating sanding disc.

The suction action drawn on the sander through the central suction holes was of assistance in holding the sander and the sanding disc down onto the hood so that it was easy to control the movement of the sander by hand.

By using this sanding system, it was possible to easily sand away a good area of the four coats of enamel and the two coats of primer on the hood in a relatively short time. However, the startling attribute about the sander was that virtually no dust escaped being collected by the system of suction openings in the backup pad of the sander. This was true, even when the edges of the hood were being sanded so that a certain portion of the sanding disc extended over the edge of the hood. Nevertheless, any dust generated was visible to the eye for only a moment before being sucked into one of the suction openings in the backup pad. Another startling feature about the sander was that virtually no dust remained adhered to the hood due to electrostatic attraction. It was possible to run a finger along the sanded surface of the hood, and almost no visible dust was picked up on the finger, even though the paint being abraded away by the sanding device was of a dark green colour.

A hose with 150 pounds of air pressure was held close to the surface of the hood but it was not possible to blow away any more dust. The slight amount of dust that was present on the hood could be removed with a polishing cloth.

The sanding disc on the backup pad could be removed readily from the backup pad by shutting off the suction to the housing by moving the shut-off knob on the side of the housing to the back and then removing the sanding disc and replacing it with a fresh sanding disc.

Example 2

The same sanding device was used as described above in Example 1. However, for this demonstration, the vacuum cleaner was disconnected and no vacuum was applied to the backup pad. The results were startling. In a matter of 15 to 30 seconds, a considerable amount of dust was generated by the sanding disc. Mounds of dust were left on the surface of the car hood. Moreover, a considerable quantity of dust began to float in the air and made working conditions very uncomfortable because one could not avoid inhaling some of the dust. Other dust floating in the air settled on the hands and the clothing of anyone standing within ten to fifteen feet of the demonstration. If the demonstration had continued for a substantial length of time, the amount of dust generated would have been virtually impossible to deal with.

Example 3

Another portion of the 1965 Ford car hood mentioned in Example 1 was sanded using an 8 inch sanding disc, driven by a 1¼ inch horsepower air turbine motor manufactured by Dotco. The sanding disc was 120 grit grade. A sponge ring was mounted between the backup pad of the 8 inch backup pad, and the 8 inch sanding disc. The backup pad had only central suction openings. The centre hole in the sanding disc was five inches in diameter. The sanding disc was driven at 1500 rpm.

Using the two horsepower EUREKA type vacuum cleaner, it was possible to readily sand the green paint from the hood of the car using only reasonable manual force to move the sander about the surface of the hood. The sanding disc moved easily about the surface of the car hood and no undue amount of hand pressure was required to hold the sanding disc against the surface of the car hood. Moreover, virtually no dust was left on the surface of the car hood, and virtually no dust entered into the atmosphere.

Example 4

The same demonstration as described in Example 3 above was conducted, except that the 1¼ inch vacuum hose of the EUREKA vacuum machine was disconnected from the suction housing of the 8 inch sander. Startling differences in performance were immediately apparent. The operator had to exert about 10 pounds hand pressure in order to hold the sanding disc against the surface of the car hood. Moreover, considerable force was required to move the sanding disc about the surface of the car hood. Within 15 to 30 seconds, a considerable amount of dust was created, which left mounds of dust on the surface of the car hood, and also was discharged into the air and remained suspended for a long period of time.

Example 5

A rectangular piece of particle board (chipboard) approximately ½ inch in thickness, and measuring 18 inches by 30 inches, was sanded using a 5 inch sander with 220 grit grade sandpaper. The backup pad had both central and peripheral suction openings. Plastics "sawdust" produced by cutting a piece of plastics sold under the trade mark NYLON, was sprinkled around the edges of the particle board and extended approximately 2 to 4 inches away from the edges of the particle board. With the vacuum machine turned on, approximately 1/8 of an inch of the particle board was sanded away at one side in about 50 to 60 seconds. However, virtually all of the sawdust generated by the rotating 5 inch sanding disc was quickly drawn away by the vacuum action of the backup pad. Moreover, the plastics "sawdust" sprinkled around the edges of the particle board was sucked up by the suction action of the backup pad from two to four inches away from the edges of the backup pad and sanding disc.

Example 6

The same particle board as described in Example 5 was used in this demonstration. However, the 8 inch sanding disc driven by the Dotco air motor that was used in Example 3 was used in place of the 5 inch sander. The sandpaper was of 16 grit grade. No vacuum was drawn on the suction outlet of the 8 inch sander. Within 15 seconds, approximately ¾ of a cup of coarse sawdust was generated by the sander. This sawdust was left on the surface and around the edges of the particle board.

The vacuum hose was then connected to the 8 inch sander and the ¾ of a cup of coarse sawdust was sucked up by the suction openings in the backup pad within a few seconds. Moreover, when the edges of the particle board were sanded by the 8 inch sander, and even when as much as 4 inches of the sanding disc overhung the edge of the particle board, none of the coarse sawdust being generated by the rotating sanding disc escaped the suction action of the various suction openings in the backup pad. Coarse sawdust would be seen to fly about one or two inches away from the edge of the sanding disc, but then it would be overtaken by the suction action of the sander and would be sucked up into one of the openings in the backup pad.

The other characteristic of this test was that when no vacuum was applied to the sander, about ten pounds of hand pressure was required to hold the 8 inch sander against the surface of the particle board. In addition, substantial force was required to move the 8 inch sander about the surface of the particle board. However, with the vacuum turned on, only reasonable manual pressure was required to hold the 8 inch sander against the surface of the particle board, and move the 8 inch sander about the surface of the particle board.

Example 7

The same Ford automobile hood and sanding system that was described in Example 1 was repeated using a backup pad with only central suction openings.

The suction action drawn on the sander by the central suction openings held the sander and sanding disc down onto the hood to such an extent that it was possible to control the movement of the sander using only the fingertips. This sanding system made it possible to sand away a substantial area of the four coats of enamel and the two coats of primer on the hood in a relatively short time. Even with only central suction openings in the backup pad virtually no dust escaped being collected by the system of central suction openings in the backup pad of the sander. This was true, even when the edges of the hood were being sanded so that a certain portion of the sanding disc extended over the edge of the hood. Any dust that was generated was visible to the eye for only a moment before being sucked into one of the central suction openings in the backup pad. Little dust remained adhered to the hood due to electrostatic attraction, although the amount remaining was greater than in Example 1. Running a finger along the sanded surface of the hood, picked up only a slight quantity of dust on the finger.

Example 8

Another portion of the 1965 Ford car hood mentioned in Example 1 was sanded using an 8 inch sanding disc, driven by a 1¼ horsepower air turbine motor manufactured by Dotco. The backup pad had both central and peripheral suction openings. The sanding disc was 120 grit grade. A sponge ring was mounted between the backup pad of the 8 inch backup pad, and the 8 inch sanding disc. The centre hole in the sanding disc was five inches in diameter. The sanding disc was driven at 1500 rpm.

Using the two horsepower EUREKA type vacuum cleaner, it was possible to sand the green paint from the hood but full manual pressure of about 10 pounds had to be used to move the sander about the surface of the hood. The suction action developed by the central and peripheral holes was effective in removing virtually all of the dust generated by the rotating sanding disc. However, a certain amount of dust remained clinging to the hood presumably by electrostatic attraction.

Example 9

A further portion of the 1965 Ford car hood mentioned in Example 1 was sanded using an 8 inch sanding disc, driven by a 1¼ horsepower air turbine motor manufactured by Dotco. The suction housing of the 8 inch sander had a suction control valve therein. The sanding disc was 120 grit grade. A spongle ring was mounted between the backup pad of the 8 inch backup pad, and the 8 inch sanding disc. The backup pad had only central suction openings. The centre hole in the sanding disc was five inches in diameter. The sanding disc was driven at 1500 rpm.

Using the two horsepower EUREKA type vacuum cleaner, it was possible to readily sand the green paint from the hood of the car using only two fingers. The sanding disc controlled by the two fingers moved easily about the surface of the car hood and little hand pressure was required to hold the sanding disc against the surface of the car hood. Moreover, virtually no dust was left on the surface of the car hood, and virtually no dust escaped into the atmosphere.

Example 10

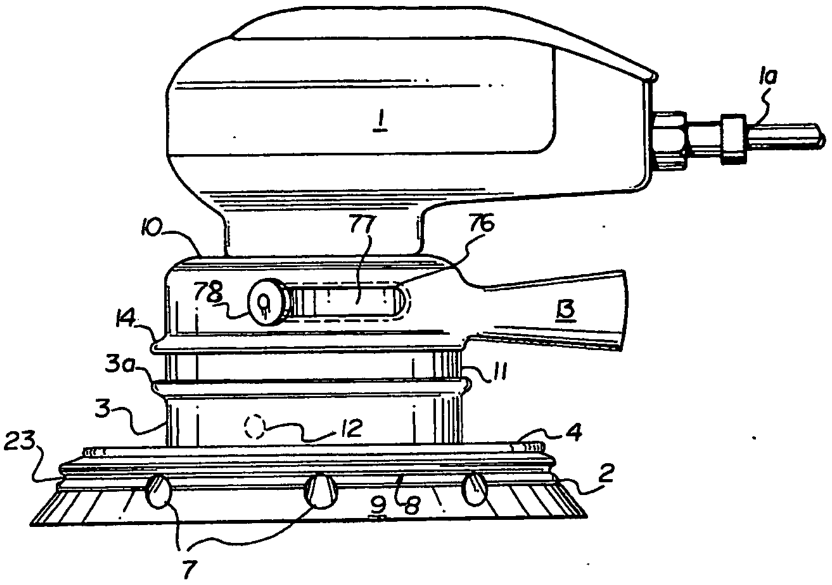

FIG. 1

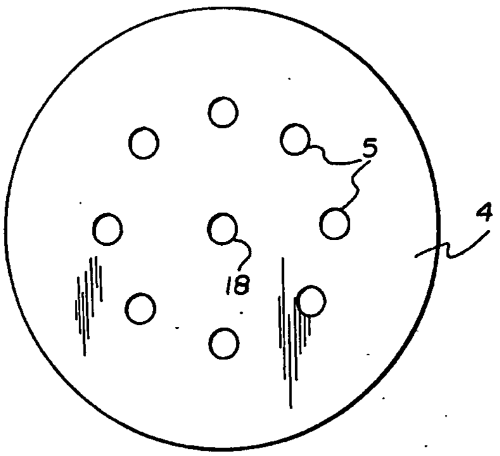

FIG. 2

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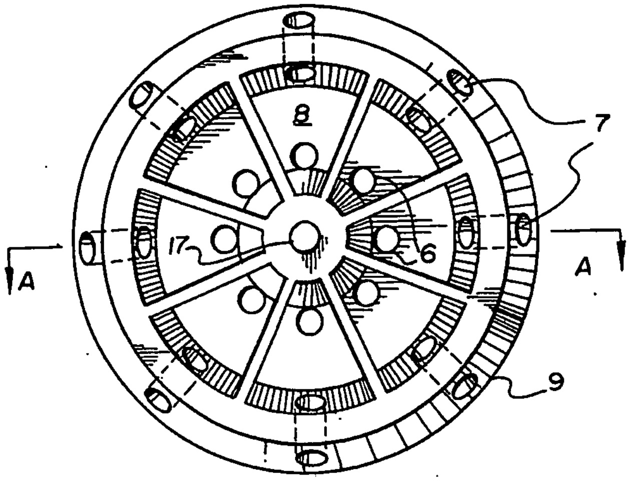

FIG. 3

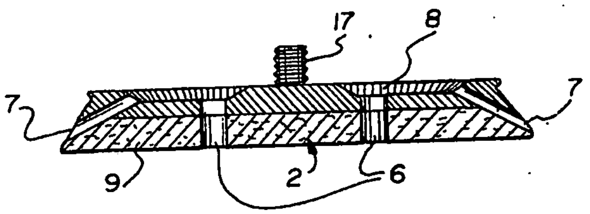

FIG. 4

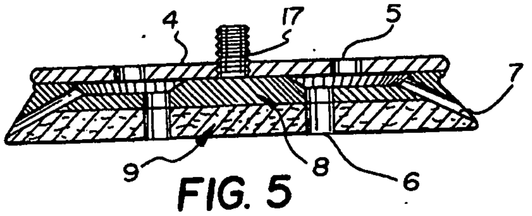

FIG. 5

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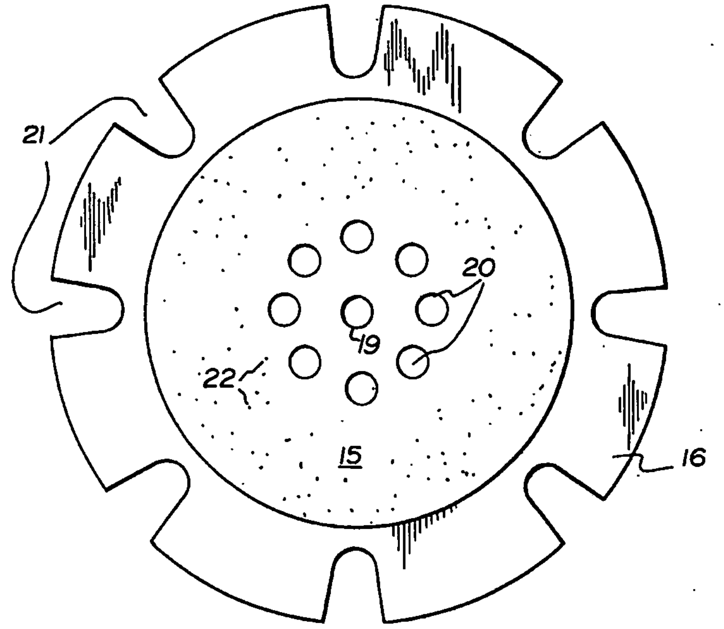

FIG. 6

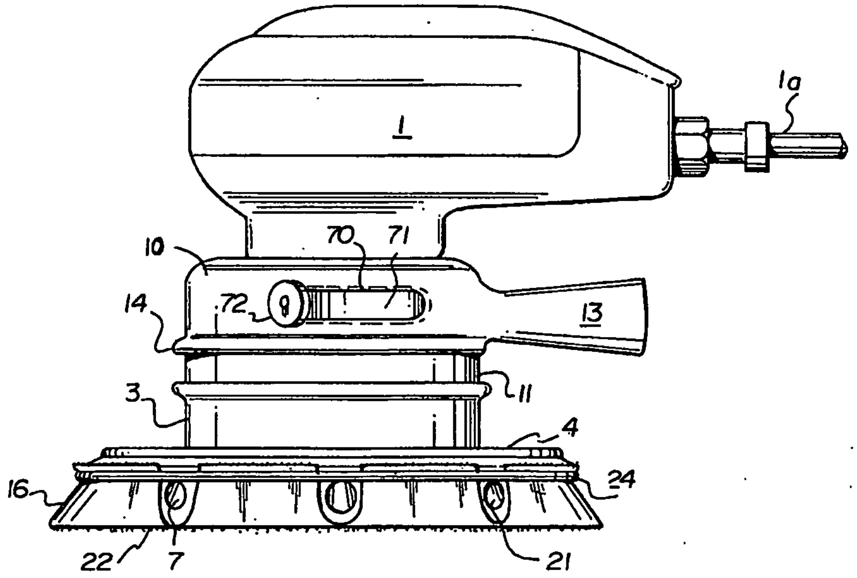

FIG. 7

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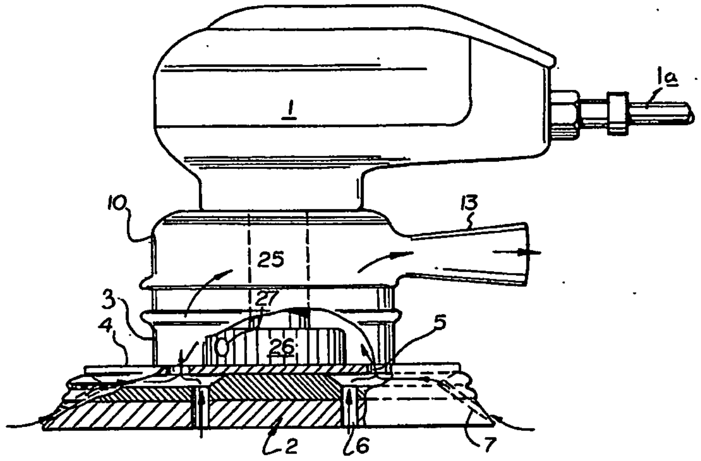

FIG. 8

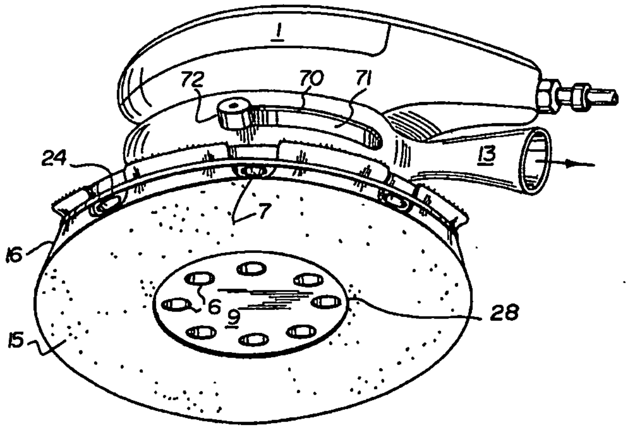

FIG. 9

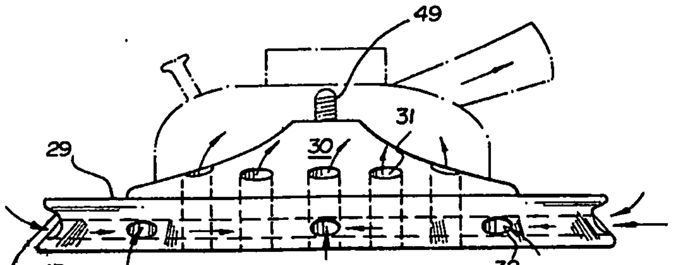

FIG. 10

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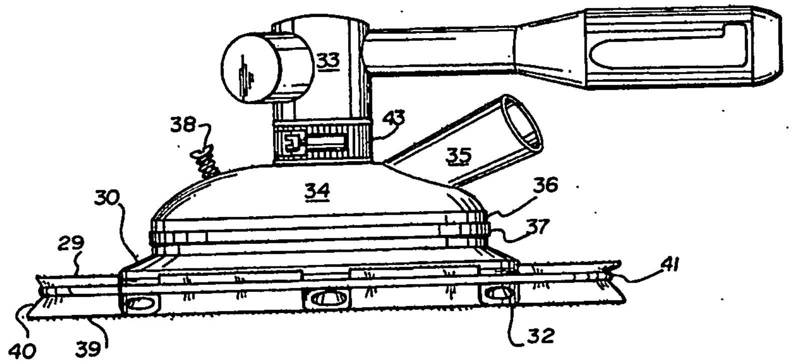

FIG. 11

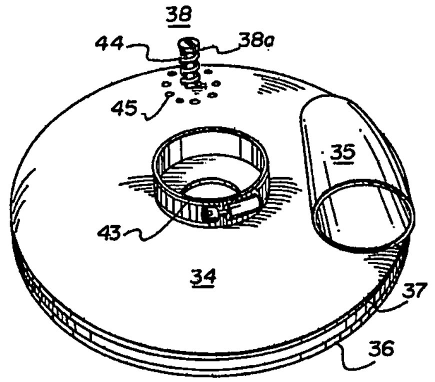

FIG. 12

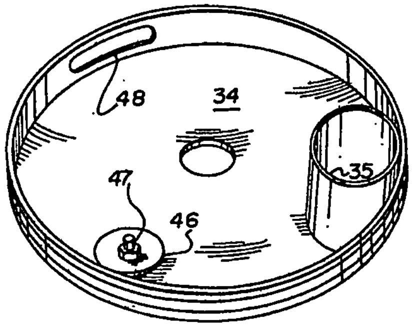

FIG. 13

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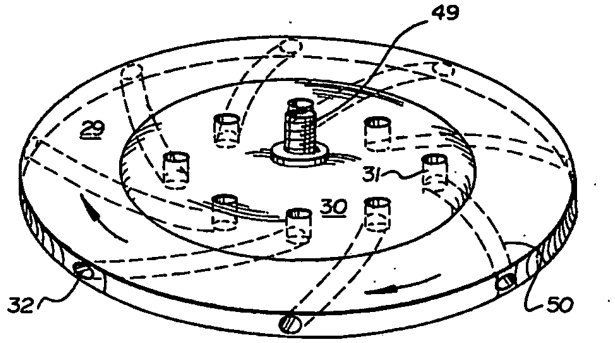

FIG. 14

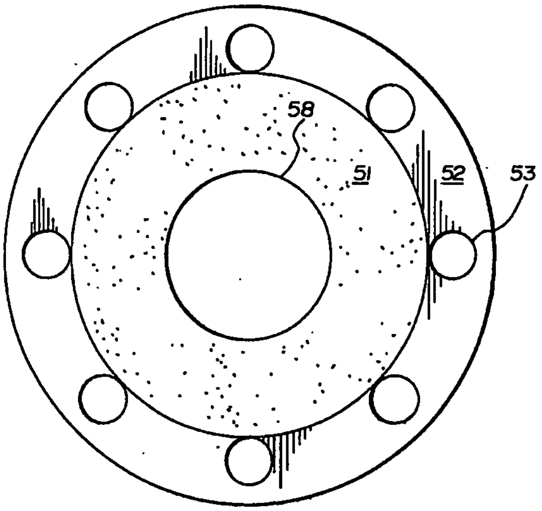

FIG. 15

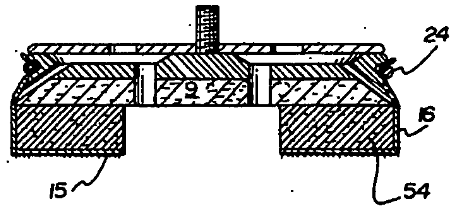

FIG. 16

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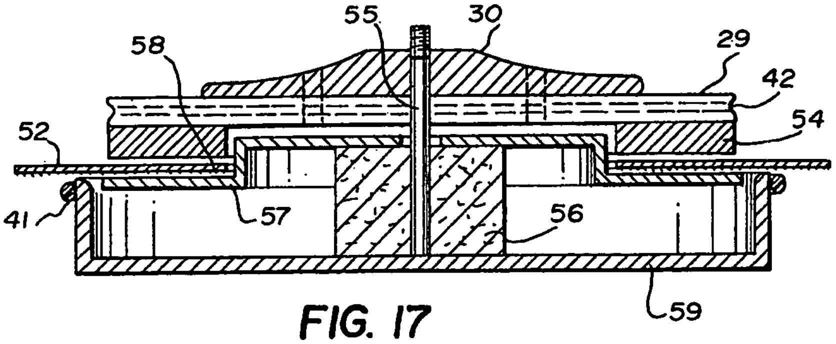

FIG. 17

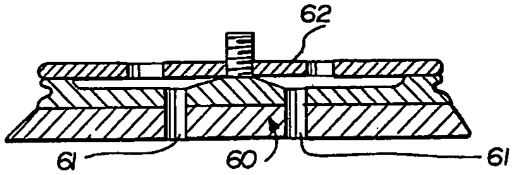

FIG. 18

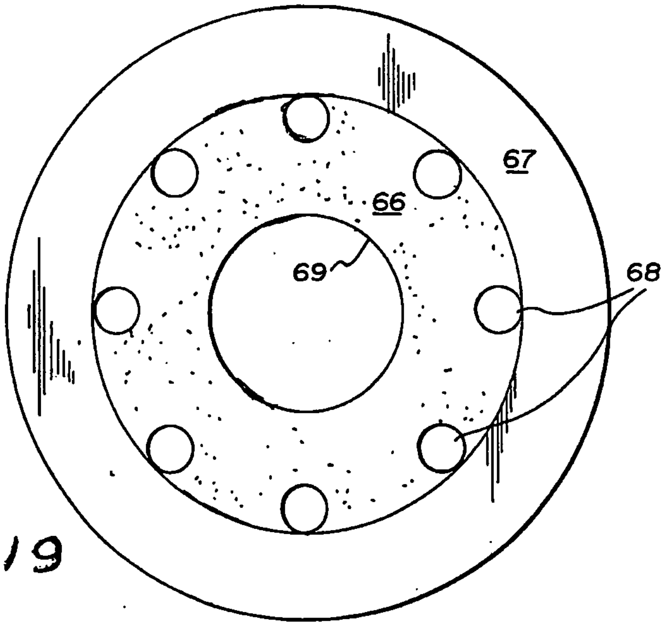

FIG. 19

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